

Amendments to the Drawings

Applicants have amended Figures 5-7 to be legible and to translate the non-English text contained in original Figures 5 and 7.

JUL 09 2007

REMARKS

By this amendment, Applicants have amended the drawings to provide legible copies of Figures 5-7 and to translate the non-English text in original Figures 5 and 7.

Applicants have also amended the claims to more clearly define their invention. In particular, Applicants have amended claim 1 to include therein the limitations previously recited in dependent claim 3. Accordingly, claim 3 has been canceled without prejudice or disclaimer. Applicants have also added new claims 4 and 5 directed to a method of optimizing the recovery of a hydrocarbon fluid in place in a stratified hydrocarbon reservoir. Claims 4 and 5 are supported by, e.g., the description at page 6, line 4 to page 7, line 4 and page 1, lines 5-11 of Applicants' specification.

In view of the foregoing amendments to the drawings, reconsideration and withdrawal of the objection to Figures 5-7 are requested.

Claims 1-3 stand rejected under 35 U.S.C. 101 as being directed to non-statutory subject matter. Applicants traverse this rejection and request reconsideration thereof.

The rejected claims relate to a method for determining, in a stratified medium whose physical properties are known or estimated, at least one zone where an interface between a fluid in place in the medium and a flushing fluid, of known different viscosities and densities, injected in the medium, moves in a stationary manner, in order to simplify construction of a model simulating the flows in the medium. The claimed method is a "process" that falls within

one of the four enumerated categories of patentable subject matter under 35 U.S.C. 101. The Supreme Court has construed section 101 broadly, noting that Congress intended statutory subject matter to "include anything under the sun that is made by man." *Diamond v. Charkrabaty*, 447 US 303, 309 (1980). Despite this seemingly limitless expanse, the Court has specifically identified three categories of unpatentable subject matter: laws of nature, natural phenomena and abstract ideas. *Diamond v. Diehr*, 450 US 175, 185 (1981); *AT&T Corp. v. Excel Communication, Inc.*, 172 F.3d, 1352, 50 USPQ 2d 1447, 1450 (Fed. Cir. 1999), *cert. denied*, 528 U.S. 946 (1999).

In the outstanding office action in this case, the Examiner alleges that "the claims as a whole are drawn to an abstract mathematical algorithm and do not provide a practical application, as evidenced by a lack of physical transformation or useful, tangible, and concrete result." However, the Examiner's reasoning is incorrect. While certain types of mathematical subject matter, standing alone, represent nothing more than abstract ideas until reduced to some type of practical application, i.e., a useful, concrete, and tangible result, a mathematical algorithm is unpatentable *only* to the extent that it represents an abstract idea. *State Street Bank & Trust v. Signature Financial Group*, 149 F.3d 1368, 47 USPQ 2d 1596, 1600-1601 (Fed. Cir. 1998), *cert. denied*, 525 U.S. 1093 (1999). Thus, unpatentable mathematical algorithms are identifiable by showing they are merely abstract ideas constituting disembodied concepts or truths that are not "useful." From a practical standpoint, this means that, to be patentable, an algorithm must be applied in a "useful" way. *State Street, supra*, 47 USPQ 2d at 1601. Here,

the claimed method produces a useful, concrete and tangible result and therefore constitutes patentable subject matter.

In the 101 rejection, the Examiner appears to require a physical transformation for the method to satisfy the "useful, concrete and tangible result" requirement. The Examiner's reliance on a physical transformation is misplaced since the tangible result requirement does not necessarily mean that a claim must either be tied to a particular machine or apparatus or must operate to change articles or materials to the different state or thing. *Manual of Patent Examining Procedure (MPEP)* §2106. See, also, *AT&T Corp.*, *supra*, 50 USPQ 2d at 1452-53.

The Court of Appeals for the Federal Circuit has examined the "useful, concrete and tangible result" requirement in a number of cases. In *In re Alappat*, 33 F.3d 1526, 31 USPQ 2d 1545 (Fed. Cir. 1994) (*in banc*), the court held that data, transformed by a machine through a series of mathematical calculations to produce a smooth waveform display on a rasterizer monitor, constituted a practical application of an abstract idea (a mathematical algorithm, formula or calculation), because it produced "a useful, concrete and tangible result," i.e., the smooth waveform.

In *Arrhythmia Research Technology Inc. v. Corazonix Corp.* 958 F.2d 1053, 22 USPQ 2d 1033 (Fed. Cir. 1992), the court held that the transformation of electrocardiograph signals from a patient's heartbeat by a machine through a series of mathematical calculations constituted a practical application of an abstract idea, (a mathematical algorithm, formula or calculation), because it corresponded to a useful, concrete or tangible thing,

i.e., the condition of a patient's heart. In *Arrythmia*, the court noted the fact that the product is numerical is not a criterion on whether the claim is directed to statutory subject matter. *Arrythmia, supra*, 958 2d at 1060, 22 USPQ 2d at 1039.

In *State Street, supra*, the court held that the transformation of data, representing discrete dollar amounts, by a machine through a series of mathematical calculations into a final share price, constituted a practical application of a mathematical algorithm, formula, or calculation, because it produces "a useful, concrete and tangible result," i.e., a final share price momentarily fixed for recording and reporting purposes.

In *AT&T, supra*, the court held that the derivation of a primary interexchange carrier (PIC) indicator using a simple mathematical principle was patentable subject matter since the claimed method produced a useful, concrete and tangible result without pre-empting other uses of the mathematical principle. The court found it irrelevant that the claims lacked a physical transformation or a physical limitation.

In the present case, the claimed method determines at least one zone where an interface between a fluid in place in the medium and a flushing fluid, of known different viscosities and densities, injected in the medium, moves in a stationary manner, in order to simplify construction of a model simulating the flows in the medium and, as presently claimed, selects the viscosity of the flushing fluid. It is clear that the selection of the viscosity of the flushing fluid is or corresponds to a useful, concrete and tangible result.

In support of the 101 rejection, the Examiner also alleges that the

claims do not provide a concrete, useful result since solutions are not assured for all cases, the Examiner referring to the enablement rejections. However, for the reasons set forth below in response to the rejection of the claims under 35 U.S.C. 112, first paragraph, the disclosure enables one skilled in the art to make and/or use the invention. Accordingly, the claims clearly provide a useful, concrete and tangible result.

For the foregoing reasons, reconsideration and withdrawal the rejection of claims 1-3 under 35 U.S.C. 101 are requested.

Claims 1-3 stand rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. Applicants traverse this rejection and request reconsideration thereof.

As pointed out on page 1, lines 5-7 of Applicants' specification, the present invention relates to a method for determining in a stratified porous medium (hydrocarbon reservoir) wherein the front or interface between fluids in place and flushing fluids moves in a stationary manner, i.e., without deformation and at constant velocity.

The example given by the Examiner in numbered sections 9 and 10 of the Office Action is not applicable to a stratified porous medium; It is only applicable to fluid directly in contact, such as a bubble (see Summary). The method of Popinet is dedicated to problems involving a moving interface in a multiphase fluid flow (see Introduction of Popinet). In this context, the motion of fluids is described by the Navier-Stokes equations. These are the used by Popinet. In the context of stratified porous medium, the motion of fluids is described by the Darcy equation.

In addition, the figure chosen by the Examiner clearly indicates a deformation of the interface. This is in contradiction with the present invention, in which the interface between fluids in place and the flushing fluids moves in a stationary manner, i.e. without deformation and at constant velocity.

One skilled in the art knows how to choose an *a priori* interface form in the claimed conditions i.e., a stratified porous medium and a front without deformation. The surface $t=0.9$ cannot correspond to a surface of a front in a stratified porous medium wherein the front or interface between fluids in place and flushing fluids moves in a stationary manner, i.e., without deformation and at constant velocity.

In numbered section 11, the Examiner discusses Rayleigh-Taylor instabilities. If a dense viscous layer rests on top of a less dense viscous layer, the lower layer will become unstable and form a Rayleigh-Taylor instability. However, in the present application, as is well known to those skilled in the art, the interface is not sub-horizontal, but sub-vertical. Therefore, the Rayleigh-Taylor instabilities cannot occur in the context of enhance oil recovery in a porous reservoir.

As to numbered section 12 of the Office Action, Applicants do not claim that the pressure is equal at any point of a part of the interface. What Applicants claim is "the pressures on either side of at least part of the interface become equal at any point of this part." Applicants equalize the pressure on the right and on the left of the interface. It is obvious there is a continuity of the pressure in the reservoir. The example taken by the

Examiner, (source and sink) is typically one of the applications; the pressure is greater on the side of the source. It decreases going towards the other zone. But it decreases continuously. So, at the interface, the pressure should be equal. If it is not possible to equalize these pressures, it means the conditions are not stationary (see page 13, lines 11 and 12, and claim 2).

For the foregoing reasons, Applicants disclosure enables one skilled in the art to make and/or use the invention.

Claims 1-3 stand rejected under 35 U.S.C. 112, second paragraph, as allegedly being incomplete for omitting essential steps. Applicants traverse this rejection and request reconsideration thereof.

In support of the rejection under 35 U.S.C. 112, second paragraph, the Examiner alleges that the omitted steps are the specifics of the steps already recited in the claims. Since the steps are already recited, by definition they cannot be missing. While the steps are recited more broadly than disclosed in the specification, it is noted that the breadth of the claim is not to be equated with indefiniteness. *In re Miller*, 441 F.2d 689, 169, U.S.P.Q. 597 (CCPA 1971); *MPEP* 2173.04.

Accordingly, amended claims 1 and 2 and new claims 4 and 5 are patentable under 35 U.S.C. 112, second paragraph.

Claims 1-3 stand rejected under 35 U.S.C. 102(b) as allegedly being clearly anticipated by Popinet et al. or Karlisen et al. Applicants traverse this rejection and request reconsideration thereof.

The Popinet document is not pertinent as it does not concern the same technical domain as the present invention. The method described in Popinet

cannot be applied in a porous medium such as a reservoir. Moreover, neither Karlsen nor Popinet describes a method wherein the form of the interface is determined iteratively according to pressure on either side of the interface. The front tracking method in Karlsen is described from page 22. Not one of the presently claimed steps is disclosed.

Accordingly, neither Popinet et al. or Karlsen et al. anticipates the claimed invention, either as set forth in claims 1 and 2 or new claims 4 and 5.

In view of the foregoing amendments and remarks, favorable reconsideration and allowance of all of the claims now in the application are requested.

Please charge any shortage in the fees due in connection with the filing of this paper, to the deposit account of Antonelli, Terry, Stout & Kraus, LLP, Deposit Account No. 01-2135 (Case: 612.45186X00), and please credit any excess fees to such deposit account.

Respectfully submitted,

ANTONELLI, TERRY, STOUT & KRAUS, LLP



Alan E. Schiavelli
Registration No. 32,087

AES/at
(703) 312-6600